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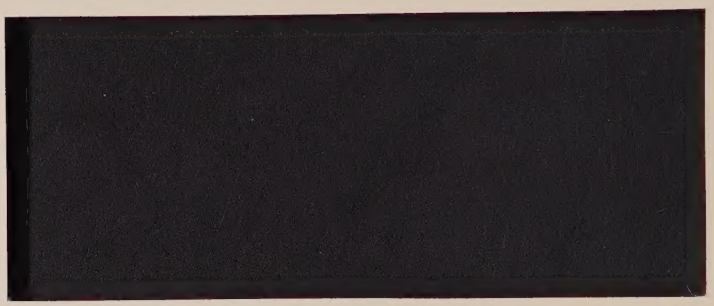

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B L H
AUTOMATIC
CALIBRATION INDICATOR
MODEL 620

(FORMERLY TYPE 65)

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INSTRUCTION MANUAL

FOR
AUTOMATIC CALIBRATION
INDICATOR
MODEL 620
(FORMERLY TYPE 65)

Designed and Manufactured by
BALDWIN-LIMA-HAMILTON CORPORATION
ELECTRONICS DIVISION
WALTHAM, MASSACHUSETTS

TABLE OF CONTENTS

General Information..... Section 1

Description..... Section 2

Installation..... Section 3

Operation..... Section 4

Calibration..... Section 5

Maintenance..... Section 6

Trouble Shooting..... Section 7

Replacement Parts List ..... Section 8

Product Data Sheets..... Appendix

BLH Bulletin 4355A

SECTION I

GENERAL INFORMATION

1.0 GENERAL INFORMATION.

1.1 The Automatic Calibration Indicator, Model 620 is a portable, precision calibration Indicator with digital readout, and when used with a high accuracy calibration Load Cell, provides an accurate means of checking and calibrating load and force measuring systems involving tension and/or compression loads. The Indicator is shown in Figure 1.

1.2 The Load Cell is specially designed to meet the exacting standards of calibration service. Based on the SR-4 Strain Gage principle, it functions as a load transducer, translating changes in load into changes in electrical values.

1.3 The Model 620 Indicator has a digital readout for fast, accurate reading. It is powered by 115 volt 60 cycle AC. A Standardizer is built into the Indicator to allow the operator to check the calibration of the Indicator at any time without having to apply a known load to the Load Cell.

1.4 The Indicator utilizes a servo driven slidewire to balance an internal bridge circuit. Standard models provide system accuracies of ±0.1% of reading from full scale down to 1/6 of full scale with a correction curve and are used for both tension and compression calibration. Direct reading Indicators for either tension or compression provide system accuracies of ±0.1% of reading from full scale down to 1/6 of full scale without a curve. Higher accuracies to ±0.05% and modifications are available to meet special requirements.

FIGURE I Model 620 Automatic Calibration Indicator

1.5 SPECIFICATIONS:

Power Source	115 volts, 60 cycle AC 35 watts, 7 feet of power cable furnished.
Load Cell Excitation	10 volts, 60 cycle AC - supplied by Calibrator.
Readout	White numberals 1/4" high on black background. All ranges have 4 rotating digit wheels.
Legend in pounds	Percent is recommended if more than one capacity of cell is used.
Number of Intervals	Six - Utilizing zero suppression.
Instrument Accuracy	±0.05% of interval.
Instrument Repeatability	±0.03% of interval.
Full Scale Range	2.4 mv/v.
Response Speed	Approximately 12 seconds per interval.
Zero Control	±5% of full scale.
Span Adjust	Internal and factory set.
Calibration Check	By switch on front of case.
Size	Approximately 6" high x 16 1/2" wide x 15" deep.
Weight	Approximately 23 lbs.

SECTION 2

DESCRIPTION

2.0 DESCRIPTION

2.1 The Automatic Calibration Indicator Model 620, Figure 1, automatically measures the voltage output of a load cell and translates it into a reading in percent of the Load Cell full load capacity or directly into lbs. (depending on readout legend).

2.1.1 Using the Load Cell as a load-sensing element, the capacity of the Indicator is changed (when counter scale is in % of full load) by substituting one Load Cell for another and using the appropriate curve.

2.2 INDICATOR. The Calibration Indicator is an automatically null-balanced, digital readout instrument. The Indicator has a total range of 0-120%, covered by 6 intervals of 20% each. Legend is in % or in pounds.

2.2.1 Circuitry of the Indicator includes a measuring circuit, amplifier, servo motor and slidewire. The difference between the Load Cell unbalance voltage and the measuring circuit voltage is fed to the amplifier. The amplifier output drives a servo motor positioning the slidewire until the measuring circuit voltage is exactly equal to the Load Cell unbalance voltage. The magnitude and phase of the voltage is dependent upon the magnitude and phase of the difference between the Load Cell and the measuring circuit voltages. Figure 2 is a functional diagram of the automatic null-balance principal.

2.2.2 The magnitude of the measuring circuit voltage is determined by the position of the slidewire potentiometer and the setting of the ADD TO READING switch. The counter is geared to the slidewire and indicates the magnitude of the measuring circuit voltage necessary to balance the Load Cell unbalance voltage. The load being measured is obtained by summing the digital counter and the ADD TO READING switch setting.

2.2.3 If the Indicator is a direct reading instrument (slope fitted), the reading as indicated is the correct reading ± a correction for temperature. If the Indicator is not a direct reading instrument correction factors must be applied as described in Section 4, Operation.

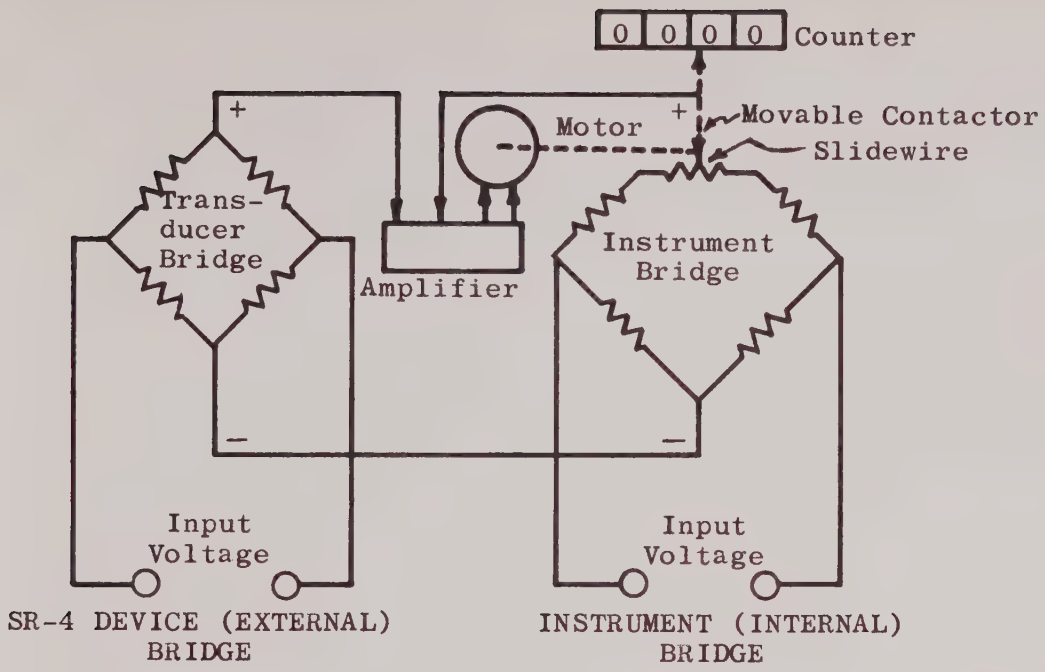


FIGURE 2. Functional Diagram, Automatic Null Balance Principal

2.2.4 A TENS.-COMP. (Tension-Compression) switch reverses the Load Cell signal input to the Indicator so either tensile or compressive loads may be measured.

2.2.5 The STANDARDIZER is used to check the calibration of the Indicator by introducing a stable, known voltage into the measuring circuit. The Standardizer reading is on the Instruction Panel (on inside of front hinged cover). If the Indicator calibration should change by a small but significant amount (.1% or more), the reading produced by the Standardizer will differ from the reading contained on the Instruction Panel. In such an event, the SPAN ADJUST control is used to calibrate the Indicator.

2.2.6 The CAPACITY BALANCE adjustment nullified the effect of undesirable capacity in the system by introducing a voltage of the proper phase to cancel out of phase voltage. The BALANCE light is the visual detector; when the light is out quadrature voltages are cancelled.

2.2.7 The POLARIZATION LIGHT indicates when the wrong polarity of the 115V AC supply is connected to the Indicator. The light is connected from the neutral side of the line to ground and will light when the hot side of the supply is connected to the neutral line of the Instrument.

2.2.8 The AMPLIFIER, mounted on left side of the instrument chassis, has a gain control and a Hum Bucking control; these controls are screwdriver adjustments. The gain should be checked (see Section 7, "Trouble Shooting") if the instrument appears sluggish, or if amplifier tubes are replaced. The Hum Bucking setting should be checked if the vacuum tube, V1 is replaced. The three amplifier tubes consist of one 12BH7 and two 12 AX7 tubes.

2.3 LOAD CELL. The Load Cell contains an elastic steel column which serves as the strain-sensitive member. Four special SR-4 resistance wire strain gages are bonded to the column in such a way that they are strained both by vertical compression and horizontal expansion of the column while nullifying the effects of side load or bending. The four gages are connected electrically to form a balanced Wheatstone Bridge. A constant voltage is applied across opposite corners of the bridge so that a change in force on the Load Cell, changing the resistance of the gages, will produce a change in the output voltage. This change in voltage is measured by the Indicator.

2.3.1 Although the Load Cell is of rugged construction and will give long trouble-free service, it should be treated carefully in order to maintain its high accuracy. The Load Cell should never be overloaded; if an accidental overload occurs, the entire Calibration Kit should be recalibrated. Actually, a Load Cell can withstand a 25% overload with no change in characteristics, but since it is difficult to estimate the extent of an overload, recalibration is the wisest course. Refer to Section 5, Calibration, for procedure to check the calibration of a cell.

2.3.2 The Load Cell must never be dropped since the thin upper diaphragm, the only relatively vulnerable part, may be dented. Any dent or other damage to the upper diaphragm is sufficient cause for a calibration check.

2.3.3 The bottom of the Load Cell is machined so that load can be applied over only a relatively small area of the base, making calibration insensitive to the type of surface on which it is loaded. For highest accuracy, it is recommended that the Load Cell be placed on a flat ground plate.

2.3.4 The compression type of Load Cell has a spherical loading button which should be loaded against a soft steel plate of a thickness approaching the diameter of the button, provided the steel plate is backed up by a rigid structural member. Care should be taken either to use a new area of the plate for each loading or to adjust the plate, if an old depression is used, so that the load on the Load Cell will not be applied eccentrically. A plate with a hardness up to

40 Rockwell "C" may be used if it is desired to minimize this depression under load. The same precautions apply to the use of the Universal Type Load Cell which is supplied with a removable compression load button. This button must always be used when this type Load Cell is operated in compression; otherwise, the application of the load directly to the flat top of the Load Cell might produce excessive eccentricity.

2.3.5 Load Cells for calibration service are calibrated with a standard 15-foot length of cable. If, for any reason, this cable length is changed by more than two feet, the system calibration will be affected and should be checked at some point between half-scale and full-scale. A correction factor, which will be applicable to all Indicator readings, may thus be obtained.

2.3.6 Load Cells are compensated for the effects of temperature on zero reading on calibration; this compensation, however is only accurate for a stabilized temperature condition. If the temperature of the cell is changing rapidly, a significant error might occur. Load Cells should, therefore, be allowed to reach ambient temperature before they are used.

2.3.7 Universal Calibration Load Cells, U-1C, for both tension and compression service are available in twelve sizes with capacities of 60, 120, 240, 600, 1200, 2400, 6000, 12,000, 24,000, 60,000, 120,000 and 240,000 pounds. Load Cells for compression service only, C-1C, are made in four sizes with capacities of 24,000, 60,000 120,000 and 240,000 pounds. Refer to pages 4 and 6 in Bulletin 4355A (supplied with this manual) for Calibration Load Cell Dimensions.

2.3.8 Refer to drawing in Appendix, for suggested fittings for tension loading of the Universal Load Cells. The National Bureau of Standards uses such fittings for calibrating this type cell; it is strongly recommended that the customer make similar fittings. On the 60, 120, 240 pound cells, which are made only in the Universal Type, tension fittings as well as a compression button are supplied. These tension fittings should always be used; the customer should make matching clevises to fit whatever type grips he is using. These fittings should be kept with the cell and returned to the Bureau of Standards for recalibration.

INSTRUMENT CENTER

3.0 INSTALLATION

3.1 If the Model 620 Automatic Calibration Indicator is packed for shipment, remove the equipment from the container. Examine all packing material to prevent loss of any item.

3.2 The Instrument is well suited to field calibration service, where power is available, as well as laboratory use. Normal precautions to avoid excessive shock, vibration or moisture should be observed. Locations where the kit will be subjected to temperatures above 110°F or below 32°F should be avoided.

3.3 The Load Cell is packed in its own carrying case. A fifteen foot signal cable is included. One end of the cable is permanently connected to the Load Cell; the other end of the cable is connected to the Load Cell connector located on the lower left side at the rear of the Indicator.

SECTION 4

OPERATION

4.0 OPERATION.

4.1 GENERAL. The instrument is supplied with a power cord having a 3 prong plug. This can be plugged into any convenient 115V, 60 cycle AC supply, however, if the source of supply has not been wired to national standards the POLARIZATION Indicator may light up indicating the wrong polarity. If this does occur, a 3 to 2 adapter may be used to reverse the supply to the instrument. Make sure the GREEN wire of the adapter is suitably grounded.

The Load Cell cable is plugged into the 8 pin M.S. receptacle at the rear of the instrument case. Basic operating instructions are given in Figures 3-1, Calibration Check, and Figure 3-2, Measuring Load.

4.1.1 It is recommended that the Indicator be checked against the Standardizer using the procedure outlined in Figure 3-1 each time the instrument is to be used.

4.2 HOW TO DETERMINE LOAD WHEN THE INSTRUMENT IS A DIRECT READING, SLOPE FITTED, INDICATOR. The load is "R," as obtained in Item 10 of Figure 3-2, ± the temperature correction. The temperature correction for the cell being used is obtained from the correction curve supplied with each instrument.

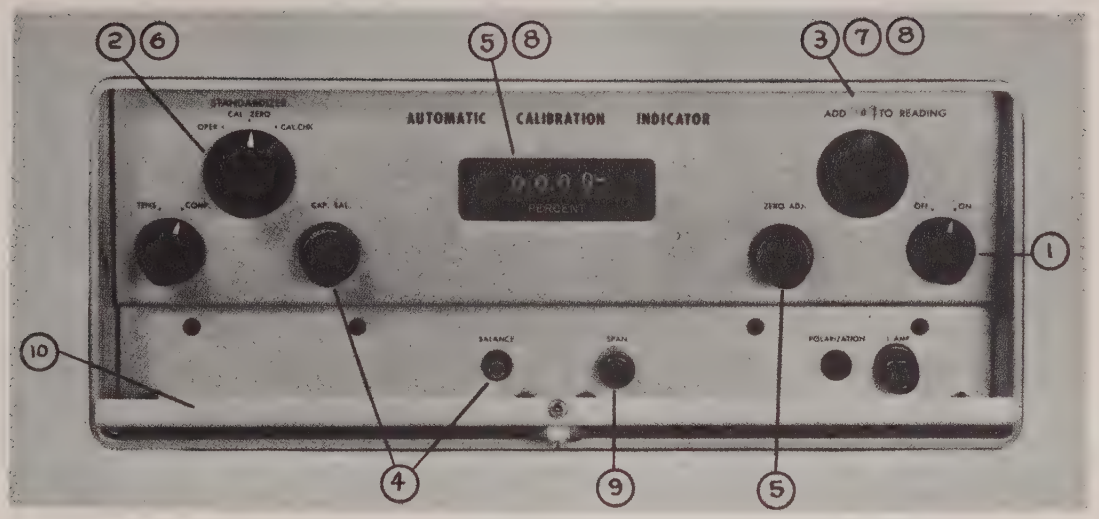
4.3 HOW TO DETERMINE LOAD WHEN THE INSTRUMENT IS NOT A DIRECT READING INSTRUMENT. The load is determined as follows:

Load = R±C ± Temperature Correction.

a. The value "R" is the instrument reading obtained in Item 10 of Figure 3-2.

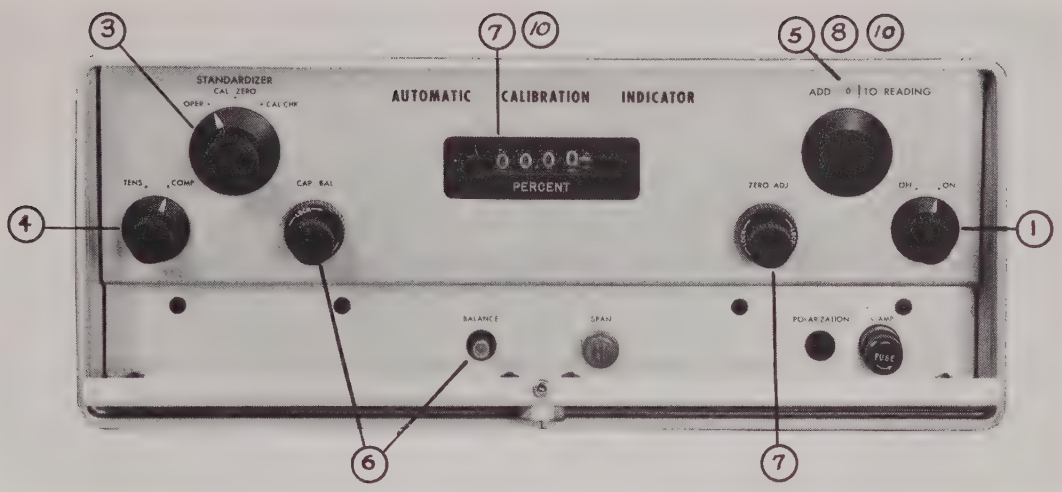
b. The value "C" is a correction factor whose value is read from a correction curve supplied with each instrument. To obtain the value "C" first locate the instrument reading "R" along the horizontal line of the graph. Then go up the graph vertically until the curve is intercepted. From this intercept point go along the graph horizontally and read "C." If the intercept point is above the "O" line add "C" to "R;" if the intercept line is below the "O" line subtract "C" from "R."

c. The temperature correction for the particular cell is obtained from the curve supplied with the instrument.



1. Turn POWER switch to ON. For maximum stability, allow 30 minutes warm-up.
2. Turn STANDARDIZER switch to CAL. ZERO position.
3. Turn ADD TO READING switch to ZERO position.
4. Adjust CAP. BAL knob until BALANCE Indicator light is out.
5. Adjust ZERO ADJ. knob until COUNTER reads (0000).
6. Turn STANDARDIZER switch to CAL CHK. position.
7. Turn ADD TO READING switch to the next to the highest position.
8. If the reading obtained, COUNTER + ADD TO READING switch, differs more than ±. 1% from the CAL. CHK. reading (10.) perform Step 9.
9. Adjust the SPAN adjustment until the reading obtained agrees within ±. 1% of the CAL. CHK. reading.
10. Repeat Step (2) and (3) and if zero has shifted, repeat Steps (5), (6), (7), (8), and (9). Repeat this procedure until no change in zero and span occur.

FIGURE 3-1. Check Calibration Procedure



1. Turn POWER switch to ON. Allow 3 minutes for warm-up.
2. Check calibration, see Figure 3-1.
3. On completion of calibration check, set STANDARDIZER switch to the OPER. position.
4. Set TENS. -COMP switch for direction of force that will be applied to the Load Cell.
5. Set the ADD TO READING switch to the zero position.
6. Adjust the CAP. BAL. knob until the BALANCE light is out.
7. With no load on the Load Cell,adjust the ZERO ADJ. knob until the COUNTER reads (0000). For best results this should be done prior to each set of readings.
8. Set the ADD TO READING switch to the position that will cover the load to be applied.
9. Apply load to the Load Cell.
10. The sum of the COUNTER and the ADD TO READING switch position is the load applied.

FIGURE 3-2. Load Measuring Procedure

SECTION 5

CALIBRATION

5.0 CALIBRATION

5.1 GENERAL. The Calibration of the Model 620 Indicator (including Load Cell) should be verified once a year by the National Bureau of Standards or Baldwin-Lima-Hamilton Corp., Waltham Mass.

5.2 LOAD CELL. Should a Load Cell be overloaded, a simple check to determine if any damage has been done to the cell, is to apply a known load to the cell. This load should be accurately known force or weight of 50% or more of the Load Cells capacity. If the reading obtained is the same as that on the curve supplied with the cell, the cell has not been damaged.

SECTION 6

MAINTENANCE

6.0 MAINTENANCE.

6.1 GENERAL. No specific maintenance is required, other than handling the instrument and Load Cell as precision instruments. Normal precautions to avoid excess shock, vibration and moisture should be observed.

SECTION 7

TROUBLE SHOOTING

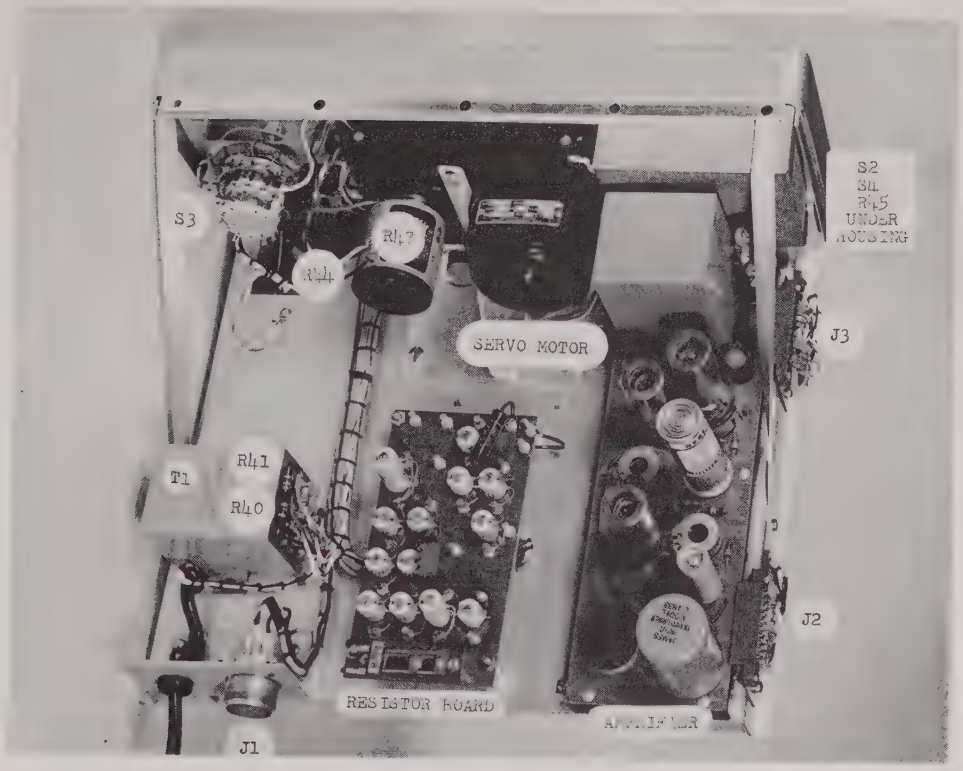
7.0 TROUBLE SHOOTING.

7.1 GENERAL. During trouble shooting refer to Figure 7, a schematic diagram of the Automatic Calibration Indicator, and Figure 6, schematic diagram of the Amplifier. To isolate the trouble to the Indicator or the Load Cell, proceed as follows:

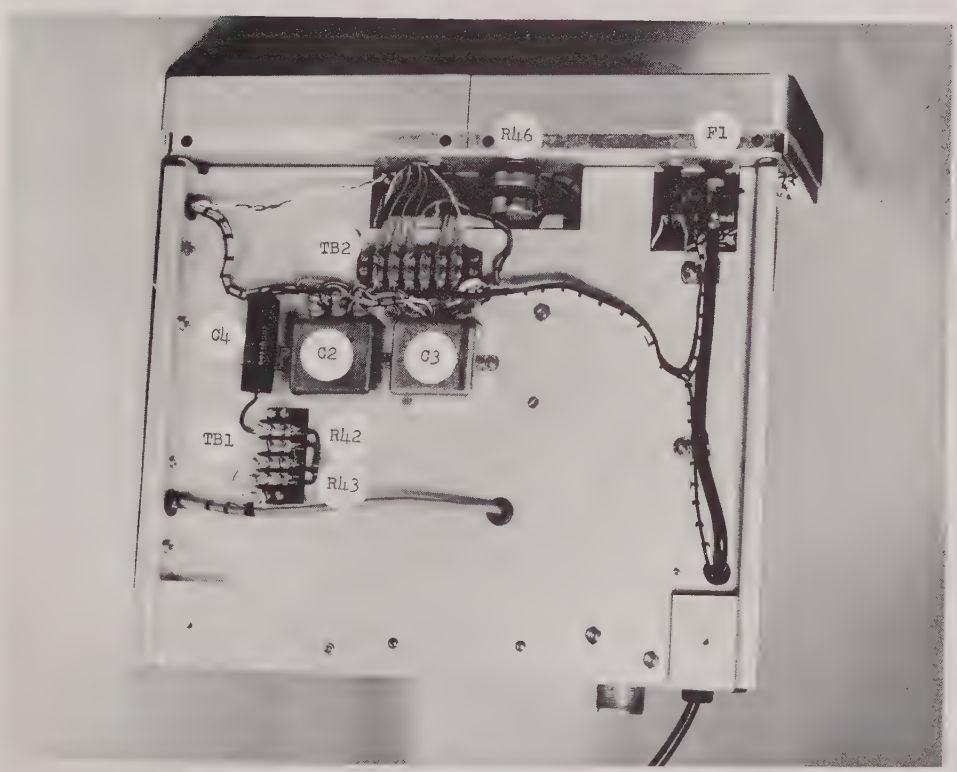
a. Perform calibration procedures per instructions in Section 4, Figure 3-1.

b. If calibration is normal then the Load Cell should be checked, refer to Section 7.2.

c. If the calibration results are abnormal, refer to Section 7.3.



Top View



Bottom View

FIGURE 4. Automatic Calibration Indicator, Component Location.

7.2 LOAD CELL. Disconnect the Load Cell from the Indicator. Using an ohmmeter, measure the resistances across the leads of the cable attached to Load Cell as follows:

CAUTION

Remember that the ohmmeter used to measure these resistances should not put more than 10-volts into the Load Cell.

a. BLACK lead to GREEN lead should measure approximately 120 ohms.

b. RED lead to WHITE lead, should measure approximately 117 ohms.

c. Any lead to shield (YELLOW) or to cell case should measure at least 100 megohms.

d. If these resistances are not correct, return the Load Cell to B-L-H with a complete history and a repair purchase order. Under no circumstances should a Load Cell be opened or otherwise serviced before its return to B-L-H.

7.3 INDICATOR

7.3.1 Check Power as follows:

a. Check Fuse on front panel.

b. Remove instrument from its case by loosening the two panel captive screws at rear of instrument and sliding instrument out of its case.

c. With an AC voltmeter check 115V supply to primary to T1, terminals J & K of J3 on the amplifier, and terminals 1 & 3 of the servo motor terminal board (underside of instrument chassis).

d. With an AC voltmeter check 1V, 2.5V & 10V secondary windings of T1.

7.3.2 If after checking the power the instrument fails to operate properly perform the following steps to determine the trouble:

a. Make certain that the Power Switch is turned ON and that power is applied to the instrument.

b. Disconnect the Load Cell from the instrument. Short the RED and WHITE Load Cell input leads of the Indicator, D or C and G or H of J1.

c. Make sure CAP. BAL. is properly adjusted.

d. Turn the zero adjustment, this should cause the instrument to drive.

e. If the action appears sluggish, that is, instrument response to control action is slow, check amplifier tubes and gain.

f. Manually force the counter gear away from the point of balance, first in one direction, then in the other. If the instrument does not return to the same balance point, the gain control should be readjusted until the counter returns to the same balance point. If gain adjustment is insufficient, check the amplifier tubes and replace weak or burned out tubes. After replacing any tubes, check the gain and readjust as necessary.

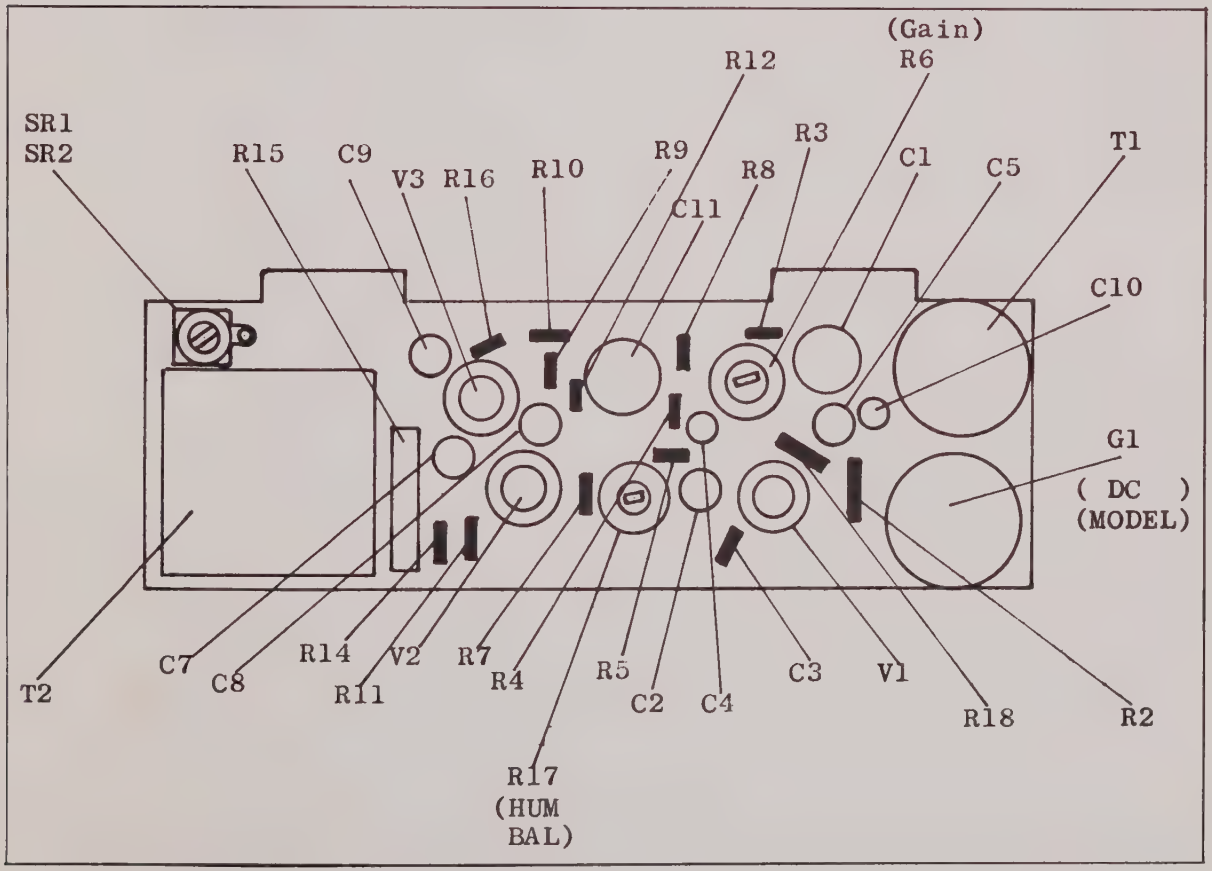


FIGURE 5 Electronic Amplifier, Top View

g. If V1 is replaced, check and adjust the Hum Bucking Control, R17 Figure 5, by connecting an oscilloscope or AC meter to either terminal 4 or 6 and ground on the terminal strip located directly below the servo motor, on the underside of the chassis. Adjust the Hum Bucking Control until the amplitude of the trace on the oscilloscope is at a minimum. If a meter is used it should indicate minimum voltage.

FIRST USED ON 204313-3 | FIRST JOB NO 130-1006

205326 — 4

NO	DWG NO	NAME	REMARKS	REQ

AMPLIFIER SCHEMATIC #D-2745

J2 J3

TB1

TB2

BRN BRN BLU GRN RED BLK WH YEL

C4 .25

220K R42

1K R43

C2A 1.0

C2B 1.0

6.3V AC PL-3

BALANCE PL-2

MOTOR

C3 1.0

R1 5K

R2 5K

R3 5K

R4 5K

R5 500

R6 150

8Ω

C5 SEL

R11 SEL.

R12 SEL.

R25 150

R20 30

R21 30

R22 30

R23 30

R24 30

F.S. R47 0

ADD TO READING

C.W. R46A 100

R46B 100

S3

R7 500

R8 500

R9 100

R10 40K

C1 .01

ZERO 1K-A2 R44

CAR. BAL. 5K-43 R45

R40 15 1V

R41 27 2.5V

10V

T1

3AMP 3AG F1

S1A S1B OFF ON

HOT NEUT. 115 V. AC 60~

PL-1 POLARIZATION

GND.

R30 31K

R26 500

R28 60

R29 60

R27 500

R31 31K

S4A S4B S4C S4D

CAL.CHK CAL.ZERO OPER

S2A S2B COMP. TENS.

J1

STANDARDIZER

SIMILAR TO DWG

GENERAL NOTES

1. ALL CAPACITANCES ARE IN MFD., ALL RESISTANCES IN OHMS.
2. SPAN RANGE ≈ ±1.25%. ZERO RANGE ≈ ±5%.
3. CALIBRATION: 2.4 MV = F.S.

REVISIONS

LTR	DESCRIPTION	DATE	APPROVED
A	WAS STD. ADDED CAP BETWEEN R47-R5 PER ECN 7411 WAS TO TB1-4 ADDED C5 PER ECN 7411	12-15-60	

UNLESS OTHERWISE NOTED
FRACT TOL ± 1/64
DEC TOL ± .005
ANGULAR TOL ± 1/2
ALL CORNERS .005 .015R
MACHINE FINISH

PROTECTIVE FINISH

MATERIAL

DRAWN H. Davis 12-15-60
CHECKED W. Carothers 12-20-60
APPROVED C. Pfeil 12-20-60
RELEASED C. Pfeil 12-20-60
E. R. W.
SCALE

BALDWIN-LIMA-HAMILTON CORP.
ELECTRONICS AND INSTRUMENTATION DIVISION
WALTHAM 54 MASSACHUSETTS

WIRING DIAGRAM
AUTOMATIC CALIBRATOR

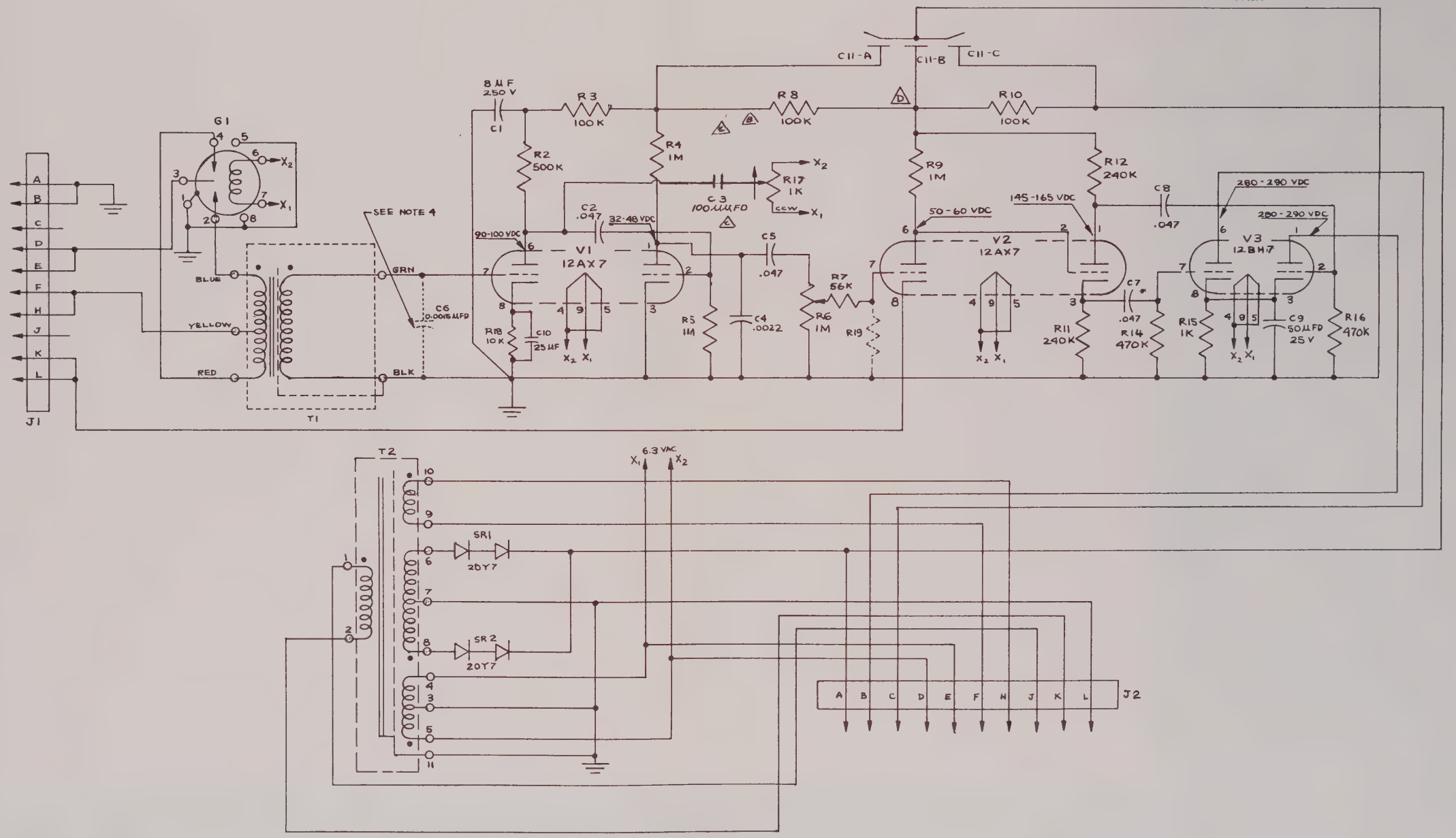
205326 — 4 REV A

FIRST USED ON	FIRST JOB NO.

NO	DWG NO	NAME	MATERIAL	REMARKS	REQ

GENERAL NOTES:

1. R2 LOW NOISE RESISTOR
2. R19 SELECTED BY B.L.H.
3. ALL D.C. VOLTAGES MEASURED BETWEEN POINT AND GROUND WITH A 20,000 OHMS/VOLT METER.
4. TO BE USED ON INSTRUMENT WITH INPUT IMPEDANCE ABOVE 3K & SPAN BELOW 3M V PER INTERVAL.



REVISIONS	
A	REVISED & REDRAWN SUPERSEDES B-1435 ECN 5183 VJC - 6-29-59
B	REVISED PER ECN 6235 ANC 4-21-60
C	REVISED PER ECN 6454 ANC 6-28-60

UNLESS OTHERWISE NOTED FRACT. TOL. ±1/64 DEC. TOL. ± .005 ANGULAR TOL. ±1/2° ALL CORNERS .005-.015R.	RE-DRAWN FB 6/29/59
	CHECKED
	APPROVED 8/11/59
PROTECTIVE FINISH	RELEASED
	ERW
MATERIAL	SCALE

BALDWIN-LIMA-HAMILTON CORP.
ELECTRONIC AND INSTRUMENTATION DIVISION
WALTHAM 54 MASSACHUSETTS

BLH AMPLIFIER, SCHEMATIC WIRING DIAGRAM

D-2745 — SIZE C

SECTION 8

PARTS LIST

NOTE

When ordering parts always include the following information.

INSTRUMENT MODEL NO.

SERIAL NO.

B-L-H PART NO.

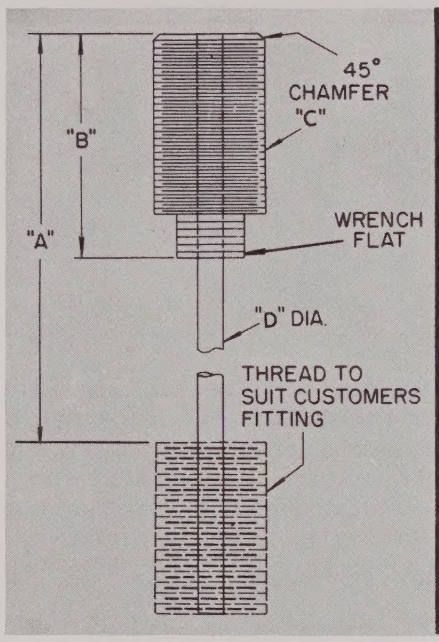
DESCRIPTION OF PART

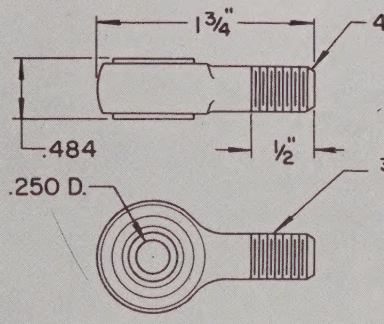
Circuit Ref.	PART DESCRIPTION	B-L-H PART NO.	Quan.
R1-R4	Resistors, Prec., w.w., 5K ±1/20%	SK6790-10	4
R5, R7, R8	Resistors, Prec., w.w., 500 ohms, ±1/2%	130355-8	3
R6	Resistor, Prec., w.w., 150 ohms, ±1/2%	130342-8	1
R9	Resistor Prec., w.w., 100 ohms ±1/2%	130338-8	1
R10	Resistor, Prec., w.w., 40K, ±1/2%	130400-8	1
R11) R12)	Selected at Calibration		
R20-R24	Resistors, 30 ohms, 1/20%	Daven Type 1250	5
R25	Resistor, 150 ohms, ±1/2%	Daven Type 1250	1
R26, R27	Resistor, 500 ohms, ±1/2%	Daven Type 1250	2
R28, R29	Resistor, 60 ohms, ±1/2%	Daven Type 1250	2
R30, R31	Resistor, 31K, ±1/2%	Daven Type 1250	2
R40	Resistor, w.w., BW 1/2, 15 ohms	132706-8	1
R41	Resistor, w.w., BW 1/2, 27 ohms	132712-8	1
R42	Resistor, Carbon, 10%, 220K	127246-8	1
R43	Resistor, Carbon, 10%, 1K	127218-8	1
R44	Potentiometer, Helipot, 10T, 1K, Type AZ	128634-8	1
R45	Potentiometer, Series 43C, 5K	133778-8	1
R46	Potentiometer, Series 43C, 100 ohms	133745-8	1
R47	Potentiometer, Spectrol Model 800, 500 ohms	204553-1	1
Trimmer	8 ohms	101724-1	1
S1, S2	Switch, Centralab PA 2003	133474-8	2
S3	Switch, Centralab PA 2023	132617-8	1
S4	Switch, Centralab PA 2011	132611-8	1
C1	Capacitor, .01 MFD, 400V	131118-8	1
C2	Capacitor, 2 x 1.0 MFD, 400V Astron MD-4-2x1M	133595-8	1
C3	Capacitor, 1.0 MFD, 600V	132511-8	1
C4	Capacitor, .25 MFD, 600V	131177-8	1
T1	Transformer	104115-1	1
J1	Connector, Receptacle	131810-8	1
J2, J3	Connector	133221-8	2
PL1	Light, Polarization	133600-8	1

Circuit Ref.	PART DESCRIPTION	B-L-H PART NO.	Quan.
PL2	Light, Balance	133599-8	1
PL3	Lamp	133219-8	1
F1	Fuse, 3 Amp.	128794-8	1
	MISCELLANEOUS		
	Motor Ass'y Holtzer-Cabot, Type RBC-2407	204554-1	1
	Fuse Holder,	131048-8	1
	Shaft lock (Span Adj.)	133585-8	1
	Knob (Cap. Bal., Zero Adj.)	124814-8	2
	Knob (Tens.-Comp., On-Off)	124850-8	2
	Knob (Standardizer, Add to Reading)	124851-8	2
	Knob Lock (Cap. Bal., Zero Adj.)	131435-8	2
	Cord Set	205184-1	1
	Amplifier Assembly	1-1989	1
	ASS'Y PLUG	101920-1	1
V1, V2	Tube 12AX7	133358-8	2
V3	Tube 12BH7	133360-8	1
T1	Input Transformer, James Vibrapower Co.	James C-1833	1
T2	Power Transformer, Berkshire Transformer	1-2023	1
SR1, SR2	Rectifier Seletron #20Y7, Radio receptor		2
R2	Resistor, Prec., Carbon 0.5M ±1%	133203-8	1
R3, R8, R10	Resistor, Prec., Carbon 100K ±10%	127242-8	3
R4, R5, R9	Resistor, Prec., Carbon 1.0M ±10%	127254-8	3
R6	Potentiometer 1 Meg. (Spec Audio Taper)	Chicago Tel Type UPM-45 #FB3579	1
R7	Resistor, Carbon, 56K, BTS 1/2	127239-8	1
R11, R12	Resistor, Carbon, 240K ±5%, BTS 1/2	129910-8	2
R14, R16	Resistor, Carbon, 0.47 Meg. ±10%, BTS 1/2	127250-8	2
R15	Resistor, W/W, 1000 ohms, ±5% (2 watt)	132919-8	1

Circuit Ref.	PART DESCRIPTION	B-L-H PART NO.	Quan.
R17	Potentiometer, 1K, Linear Taper	Chicago Tel. Type UPM-45 #DR4783	1
R18	Resistor, Prec., Carbon, 10K ±1%, CP 1/2 Carbon film low noise	129724-8	1
R19	Resistor, Prec., Carbon, Select Value, ±1% CP 1/2 Carbon film low noise		1
C1	Capacitor, 8MFD, 250V Dual Leads	Aerovox Type PRSD	1
C2, C5, C7, C8	Capacitor, .047 MFD 400 VDC	Cornell DUB. BC 4S47J	4
C3	Capacitor, 100 MMFD 500 VDC, Mica	D. D. 22AST1	1
C4	Capacitor, 0022 MFD 400 VDC	C. D. BC4D22J	1
C9	Capacitor, 50 MFD 25 VDC	200472-1	1
C10	Capacitor, 25 MFD 10V	Aerovox Type TNED	1
C11	Capacitor, 10-10-10 MFD 450V	Aerovox AFH 3-31	1
	Tube Socket, Printed Circuit, Shield base 9 Pin	ELCO 623	3
	Socket, 8 Pin Octal	ELCO 612-1/8	1
	Printed Circuit Board	2-1538	1

TENSION FITTINGS



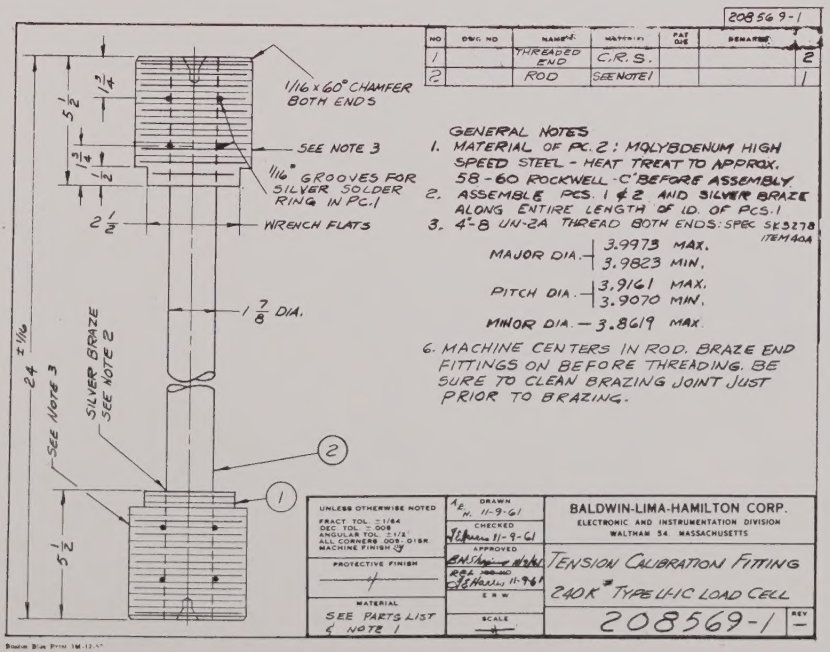


3/8-24, UNF-2 A
MAJOR O.D. .3739
MINOR O.D. .3701
MAX. PITCH DIA. .3468
MIN. PITCH DIA. .3430
ROOT DIAMETER .3239

TENSION FITTINGS SUPPLIED WITH 60 LB.; 120 LB., AND 240 LB. UNIVERSAL CALIBRATION CELLS

The fittings above are supplied with 60, 120 and 240 lb. Universal Calibration Cells. Tension fittings for higher capacity cells may be prepared by the customer. The fitting shown at left (dimensions below) is recommended, and is the same as that employed by the National Bureau of Standards in calibrating the kit.

DIM.	CELL CAPACITY							
	600	1,200	2,400	6,000	12,000	24,000	60,000	120,000
A	5½	5½	5½	12	12	12	12	14
B	1¼	1¼	1¼	2	2	2	2¼	3¼
C	½"–20 UNF-2A Max. O.D. 0.4987 Min. O.D. 0.4906 Max. Pitch Dia. 0.4662 Min. Pitch Dia. 0.4619 Max. Root Dia. 0.4446	½"–20 UNF-2A Max. O.D. 0.4987 Min. O.D. 0.4906 Max. Pitch Dia. 0.4662 Min. Pitch Dia. 0.4619 Max. Root Dia. 0.4446	½"–20 UNF-2A Max. O.D. 0.4987 Min. O.D. 0.4906 Max. Pitch Dia. 0.4662 Min. Pitch Dia. 0.4619 Max. Root Dia. 0.4446	1"–14 NF-2A Max. O.D. 0.9983 Min. O.D. 0.9880 Max. Pitch Dia. 0.9519 Min. Pitch Dia. 0.9463 Max. Root Dia. 0.9210	1"–14 NF-2A Max. O.D. 0.9983 Min. O.D. 0.9880 Max. Pitch Dia. 0.9519 Min. Pitch Dia. 0.9463 Max. Root Dia. 0.9210	1½"–12 UNF-2A Max. O.D. 1.4981 Min. O.D. 1.4867 Max. Pitch Dia. 1.4440 Min. Pitch Dia. 1.4376 Max. Root Dia. 1.4079	2"–12 UN-2A Max. O.D. 1.9982 Min. O.D. 1.9868 Max. Pitch Dia. 1.9441 Min. Pitch Dia. 1.9380 Max. Root Dia. 1.9080	3"–8 N-2A Max. O.D. 2.9974 Min. O.D. 2.9824 Max. Pitch Dia. 2.9162 Min. Pitch Dia. 2.9077 Max. Root Dia. 2.8620
D	1/8	1/8	3/16	5/16	7/16	9/16	13/16	1 3/16


208569-1
NO | DWG. NO | NAME | MATERIAL | PAT DWG | REMARKS | QTY
1 | | THREADED END | C.R.S. | | | 2
2 | | ROD | SEE NOTE 1 | | | 1
1/16 x 60° CHAMFER BOTH ENDS
SEE NOTE 3
1/16" GROOVES FOR SILVER SOLDER RING IN PC.1
WRENCH FLATS
1 7/8 DIA.
SILVER BRAZE SEE NOTE 2
SEE NOTE 3
5 1/2
1 1/4
1 3/4
2 1/2
24 ± 1/16
GENERAL NOTES
1. MATERIAL OF PC. 2 : MOLYBDENUM HIGH SPEED STEEL - HEAT TREAT TO APPROX. 58 - 60 ROCKWELL 'C' BEFORE ASSEMBLY.
2. ASSEMBLE PCS. 1 & 2 AND SILVER BRAZE ALONG ENTIRE LENGTH OF I.D. OF PCS. 1
3. 4"-8 UNI-2A THREAD BOTH ENDS: SPEC SE3278 ITEM 40A
MAJOR DIA. 3.9973 MAX. 3.9823 MIN.
PITCH DIA. 3.9161 MAX. 3.9070 MIN.
MINOR DIA. — 3.8619 MAX.
6. MACHINE CENTERS IN ROD. BRAZE END FITTINGS ON BEFORE THREADING. BE SURE TO CLEAN BRAZING JOINT JUST PRIOR TO BRAZING.
UNLESS OTHERWISE NOTED
FRACT. TOL. ± 1/64
DEC. TOL. = .005
ANGULAR TOL. ± 1/2°
ALL CORNERS .005-.015R
MACHINE FINISH
PROTECTIVE FINISH
MATERIAL
SEE PARTS LIST & NOTE 1
DRAWN
CHECKED
APPROVED
SCALE
BALDWIN-LIMA-HAMILTON CORP.
ELECTRONIC AND INSTRUMENTATION DIVISION
WALTHAM 54, MASSACHUSETTS
TENSION CALIBRATION FITTING
240K # TYPE LHC LOAD CELL
208569-1
REV

BLH

93657